

Effects of Children's and Mothers' Bodyweight on Childhood Educational Achievement

Shah Saeed Hassan Chowdhury¹
Department of Economics and Finance
Middle Tennessee State University
Email: hchowdh@yahoo.com

September 1, 2008

¹ The author is a Faculty in the Department of Finance and Banking, University of Rajshahi, Bangladesh. Now he is on leave to the USA and also pursuing his PhD in the Department of Economics and Finance, Middle Tennessee State University (MTSU). This paper is based on a term paper in Labor Economics at MTSU.

Effects of Children's and Mothers' Bodyweight on Childhood Educational Achievement

1. Introduction

Obesity and over-weight are now considered as preventable cause for death and disease as cigarette smoking. Obesity rates have drastically increased in the USA in the last three decades. Since obesity has become a severe problem for the government and society, researchers, policy makers, and academics have been exploring various issues regarding direct and indirect reasons and consequences of obesity. Healthier policy formulation largely depends on this phenomenon. Now the situation is so worse that even the obesity of children/minors has become an important policy issue in the last 20 years. In this period average BMI (Body Mass Index) of children drastically increased. It is conceivable that if children obesity can be reduced the adult obesity will also be controlled automatically as a natural consequence.

Researchers have mainly focused on the reasons for obesity and effects of obesity on wage, disease and educational performance. Cawley (2004) studies the effect of body weight on a person's wage. Hofferth and Curtin (2003) investigate the relationship between low income and overweight for elementary school age children and the contribution of food stamps and national school lunch program to this phenomenon. Kimm *et al.* (1996) show an inverse relationship between income and obesity among white girls. Fertig *et al.* (2006) explore how maternal employment affects childhood obesity. Cawley and Danziger (2004) investigate whether obesity is a barrier to employment and earnings for current and former welfare recipients. Baum and Ford (2004) use fixed effect models to test for the ways how obesity can be related to labor market outcomes.

There are many other papers that have investigated the obesity-labor market relationship. However, only few papers have investigated the effect of obesity on childhood educational performance. Sabia (2007) investigates the effects of bodyweight on adolescent academic performance. Crosnoe and Muller (2004) and Sergeant and Blanchflower (1994)

also investigate same issue. Kaester and Grossman (2008) and Averett (2007) also study the effect of obesity on childhood academic performance. Although pervious studies show that there is a negative relation between obesity and academic performance, it is not possible to come to a robust conclusion based on only few studies. Further research on this issue is required because more research means more possibility for resolving the omitted variable effect, resulting in stronger conclusion. Specially it is true in the context when mapping an exact empirical specification and theoretical models for children's academic performance is difficult (Todd and Wolpin, 2003).

When obesity is considered it is better to include health condition of both children and their mother. For example, obesity of mother may cause her to be lazy, which in turn may cause her to provide less time for their children. Thus as a policy issue the weight status of both children and mother is to be included in the relevant statistical framework. It is especially important in this case because the young children may not have the psychological and mental development yet which may impact on their personality and therefore on educational performance. In this paper I have focused on the relation between the weight of the children and mother and the educational outcomes of children. PIAT (Peabody Individual Achievement Test) – Mathematics, PIAT – Reading and PIAT – Reading Comprehension examination results are used to measure the educational performances of children.

Children and respective mother BMIs are main explanatory variables and various child- and mother-specific control variables are also introduced to handle omitted variable problems. Findings show that BMI of children does not affect educational performance, but mothers' BMI significantly negatively impact children's educational performance. Interestingly fixed effect model results for within individuals suggest that neither mothers' weight nor children's weight has any effect on educational attainment. The reason may be that children at childhood may not develop any significant behavioral effects/responses of overweight which may emerge as they get older. Thus the effect of overweight may not be visualized until children form personality in the later years of their life.

The paper is organized as follows. Next section describes the previous literature regarding childhood obesity. Section 3 discusses the data used in the study and relevant

statistical methods. Section 4 discusses the empirical results obtained from the statistical models. Section 5 concludes the paper.

2. Previous Literature: Obesity and Childhood Educational Performance

Edwards and Grossman (1979) study the weight-educational performance relationship for 6- to 11-year children using the National Health Examination Survey (NHES) undertaken between 1963 and 1965. They find negative but insignificant relationship. Shakotko *et al.* (1981) do similar study using two consecutive NHES surveys and find positive but insignificant relationship. Gortmaker *et al.* (1993) show that as compared to normal weight women, overweight women have achieved fewer years of education five years later.

Sabia (2007) builds on the work done by Cawley (2004). He uses fixed effects and instrumental variables methods to capture the effect of obesity on adolescents aged from 14 to 17. His findings show that there is negative relationship between obesity and GPA. Using ECLS-K data Datar and Sturm (2006) have used a nationally representative sample of US children who entered kindergarten in 1998, with longitudinal data in body mass index and school outcomes at kindergarten entry and end of third grade. They use wide range of educational outcomes. show that there exists some relationship between overweight status and math and reading test scores and grade repetition. More specifically, they find the overweight girls have lower math and reading test scores than those who are never overweight.

Crosnoe and Muller (2004) find that adolescent groups having more than 85 percentile score in bodyweight obtain lower mean GPAs than the groups having less than 85 percentile score in bodyweight, Averett and Stifel (2007) find negative relationship between overweight and reading scores for children aged 14 – 17. They conclude that girls who become overweight during the early school years and those who start school being overweight and remain that may need to be monitored carefully. Sigfusdotirr *et al.* (2006) investigate the effect of BMI on Icelandic youths and find negative association between weight and educational achievements.

Probably the most closely related article to this paper is written by Kaestner and Grossman (2008). They use 1979 cohort of the NLSY data that contain a national sample of children aged between 5 and 12. The sample covers the period from 1986 through 2004. Their findings show that overweight and obese children have same test scores as the average weight children. Thus there is no relationship between bodyweight and educational performance.

3. Data and Methodology

Mothers' data are collected from 1979 cohort of National Longitudinal Survey of Youth (NLSY). Since 1986 NLSY reports data biennially on the children of the mothers covered in NLSY79. Mothers' and their children's data are collected from 1986 through 2006, which is the latest year of reporting. Data only include the children aged 72 months (6 years) through 144 months (12 years). Thus the data used for the study are children's and their mothers' data for the years 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, and 2006. BMIs are calculated as weight in pounds divided by height in inches squared times 703. Some researchers criticize the continuous BMI as measure of obesity and prefer categorical measures of obesity, which is thought be able to pick up non-linear effects (Norton and Han, 2007). It is not relevant in this case because this study does not require any non-linear estimation. Children's academic performance is measured by the tests – PIAT (Peabody Individual Achievement Test) - Mathematics, PIAT – Reading Recognition, and PIAT - Reading Comprehension. However, when fixed effect regressions are run, individual data with single year are omitted from the sample. The main explanatory variables are children's and mothers' BMIs. The control variables used in the study include age of mother, number of children of mother, family size, mothers' work type as full or part time, residence in urban or rural area, mothers' marital status, region of residence, log of income of mother, highest grade completed by mother, and alcohol consumption. Children-specific explanatory

variables include age of child, behavioral index, race, sex, residence in mothers' household or not.²Of course, some variables are both mother- and child-specific.³

Finally, an individual fixed effect model is used. It controls for time-invariant individual-specific unobserved heterogeneity. For example, it should be able to control for the unobservable child-specific and mother-specific psychological makeup, motivation, attitudes, biases etc. Thus fixed effect estimates produce unbiased estimates of the effect of BMI of mother and child on child's academic performance. However, existence of sufficient individual level variation in child's and mother's weight and academic performance is necessary to make fixed effects models strong enough to track significant effect. Both within and between the group effects are estimated. Data are sorted and preliminary regressions are done using SAS and panel data effects are estimated by STATA. However, *Proc panel* command in SAS is a new addition and can handle panel data estimation (also unbalanced panel).

4. Empirical Results

Table 1 presents the means of the variables used in the study. Means are calculated and reported based on full sample, race and sex. After elimination of observations with any missing values there are 8,594 observations. The mean BMI of children as well as mothers of black and Hispanics are larger than those of white and other races. Although small, female children and mothers also tend to have larger BMI than males. Average PIAT scores for whites are about 5 points higher than blacks and Hispanics. Thus although there seems to be a negative relationship between test score and weight, but probably it is so due to racial differences.

² Other dichotomous variables like the school type, TV watching, father's residence, child's health limitations, spouse's education level etc. are considered but later dropped because these variables are not reported by NLSY for some of the years.

³ Quadratic and interaction terms of some of the variables have been used but later have been dropped as they do not change the results that much.

Table 1. Mean Values of Variables

Variables	Full Sample	Black and Hispanic	White and Others	Male	Female
N	8594	3947	4647	4236	4358
BMI - Children	18.04	18.52	17.63	17.95	18.13
BMI - Mother	26.01	27.28	24.94	25.97	26.06
PIAT - M	102.83	99.08	106.01	103.04	102.63
PIAT - R	105.84	103.14	108.14	104.71	106.95
PIAT - C	103.49	100.82	105.75	102.56	104.38
Behavioral Index	119.25	118.67	120.34	120.36	118.79
Age of child (month)	109.84	110.32	109.44	110.18	109.51
No. of children	2.40	2.49	2.32	2.41	2.38
Highest grade completed by mother	12.78	12.48	13.02	12.76	12.79
Log(Income)	9.27	9.28	9.29	9.27	9.27
Family size	4.23	4.30	4.16	4.23	4.22
Age of mother (year)	34.02	33.41	34.53	34.05	33.99
Alcohol consumed last month?	0.61	0.55	0.66	0.60	0.62
Work (part-time)	0.25	0.22	0.28	0.25	0.25
Urban	0.76	0.86	0.68	0.76	0.76
Hispanic	0.18	----	----	0.19	0.18
Black	0.28	----	----	0.27	0.28
White and others	0.55	----	----	0.54	0.54
Sex (male)	0.49	0.49	0.49	----	----
Residence with mother	0.98	0.98	0.98	0.98	0.98
Married	0.65	0.51	0.76	0.64	0.65
Not married	0.11	0.21	0.03	0.12	0.10
Separated	0.08	0.12	0.04	0.08	0.07
Region - North	0.14	0.11	0.17	0.15	0.15
Region - North Central	0.27	0.15	0.37	0.27	0.27
Region - South	0.40	0.51	0.30	0.39	0.40
Region - West	0.19	0.23	0.15	0.19	0.19

Table 2 provides the ordinary least squares results based on sex and age. Panel A and panel B give the results for males and females, respectively. For the full sample of male children, PIAT-C and PIAT-R have significantly positive relationship with children weight whereas female children do not show any significant relationship. Both sexes show that there is significantly negative relationship between mother bodyweight and children educational performance. This suggests that the overweight mothers are possibly lazier and cannot contribute to the children's educational inputs. When children are categorized with respect to age, male children's educational achievements are found to be more profoundly related to bodyweight. It is also noticeable that whenever children have significant relationship between BMI and education, it is always positive in sign, suggesting for

positive effect (or may be attitude) of having more bodyweight at earlier ages. As a contrast, according to previous literature, bodyweight negatively impacts on education and wage of obese people.

Table 2. Regression (OLS) Results for Age Groups Based on Sex

Explanatory Variable	Dependent Variable		
	PIAT- C	PIAT- R	PIAT - M
<i>Panel A: Sex = Male</i>			
Full Sample			
BMI - Children	0.1664 (0.0517)*	0.1386 (0.0548)*	0.0371 (0.0523)
BMI - Mother	-0.2827 (0.0361)*	-0.2687 (0.0382)*	-0.2235 (0.0365)*
96 ≥ age ≥ 72 months			
BMI - Children	0.0460 (0.0970)	-0.0130 (0.1027)	-0.0615 (0.1002)
BMI - Mother	-0.1585 (0.0562)*	-0.1437 (0.0595)*	-0.1038 (0.0581)
120 ≥ age > 96 months			
BMI - Children	0.1326 (0.0956)	0.1202 (0.1006)	0.0489 (0.0962)
BMI - Mother	-0.3078(0.0628)*	-0.3187(0.0661)*	-0.2147 (0.0632)*
144 ≥ age > 120 months			
BMI - Children	0.2655 (0.0798)*	0.23578 (0.0860)*	0.0742 (0.0809)
BMI - Mother	-0.3423 (0.0649)*	-0.3061 (0.0699)*	-0.3106 (0.0658)*
<i>Panel B: Sex = Female</i>			
Full Sample			
BMI - Children	-0.0789 (0.0450)	-0.0396 (0.0467)	0.0821 (0.0470)
BMI - Mother	0.1092 (0.0312)*	-0.0704 (0.0324)*	-0.1182 (0.0326)*
96 ≥ age ≥ 72 months			
BMI - Children	0.0372 (0.0878)	-0.0186 (0.0833)	0.1467 (0.0927)
BMI - Mother	0.0908 (0.0509)	-0.1000 (0.0512)	-0.1414 (0.0538)*
120 ≥ age > 96 months			
BMI - Children	-0.0799 (0.0757)	-0.0441 (0.0784)	0.0926 (0.0784)
BMI - Mother	-0.0906 (0.0543)	0.0429 (0.0563)	-0.0234 (0.0563)
144 ≥ age > 120 months			
BMI - Children	-0.0811 (0.0744)	-0.0324 (0.0796)	0.0540 (0.0783)
BMI - Mother	-0.1259 (0.0553)*	-0.0637 (0.0591)	-0.1793 (0.0581)*

Note: Values in the parenthesis are standard errors. Asterisks indicate significance at 5% level. Coefficients of control variables are suppressed. Appropriate measures are taken to avoid dummy variable trap. The control variables used in the study include age of mother, number of children of mother, family size, mothers' work type (binary), residence in urban or rural area (binary), mothers' marital status (binary), region of residence (binary), log of income of mother, highest grade completed by mother, alcohol consumption (binary), age of child, behavioral index, race (binary), sex (binary), residence in mothers' household or not (binary).

Table 3 provides OLS regression results for male and female children with various age groups. Results closely match with the results found in table 2. In most cases mother bodyweight is inversely related to the children educational performance. The effects of mothers' bodyweight are found to be more prominent in case of black and Hispanic.

Fixed effects model is effective way to control for omitted variables in panel data when the omitted variables (observable and unobservable characteristics) vary across individuals but do not change over time. For example, there can be cultural, motivational, psychological or attitudinal differences among the individuals affecting the childhood educational outcome which also probably change very slowly through time. I also assume that there is nothing which is stable across individuals but evolve over time, which allows for avoiding the time fixed effects regression.

In this kind of research endogeneity bias is an important consideration because due to reverse causality academic performance may affect obesity. However in this case children are of small age so that this kind of reverse causality should not take place. Moreover, children are not big enough to perceive obesity as that bad and thus reverse relationship is less likely. Thus no instrumental variables are introduced. To incorporate fixed effect regression in a panel the dataset is set to have at least two observations per individual. Table 4 presents the results when within and between the groups fixed effects frameworks are considered. Since it is a long cross-sectional dataset, within effect model is used because it transforms variables using group means and avoid individual dummies. The between effect model uses aggregate information or group means of variables. That is, groups of individuals are considered instead of individuals. Although not reported, *Hausman test* is done and null of random effect model is rejected.

Table 3. Regression (OLS) Results for Age Groups Based on Race

Variables	Dependent Variable		
	PIAT- C	PIAT- R	PIAT - M
<i>Panel A: Black and Hispanic</i>			
Full Data			
BMI - Children	0.03670 (0.0465)	0.0799 (0.0491)	0.1188 (0.0482)
BMI - Mother	-0.2422 (0.0341) *	-0.2070 (0.0361) *	-0.2206 (0.0354) *
96 ≥ age ≥ 72 months			
BMI - Children	0.0510 (0.0826)	0.0435 (0.0882)	0.1060 (0.0942)
BMI - Mother	-0.1849 (0.0521) *	-0.1531 (0.0555) *	-0.1738 (0.0594) *
120 ≥ age > 96 months			
BMI - Children	-0.0393 (0.0838)	-0.0536 (0.0883)	0.0728 (0.0845)
BMI - Mother	-0.1663 (0.0608) *	-0.1501 (0.0641) *	-0.1469 (0.0613) *
144 ≥ age > 120 months			
BMI - Children	0.0913 (0.0753)	0.1964 (0.0800) *	0.1588 (0.0766) *
BMI - Mother	-0.3392 (0.0608) *	-0.2908 (0.0646) *	-0.3179 (0.0619) *
<i>Panel B: White and others</i>			
Full Data			
BMI - Children	0.0575 (0.0509)	0.0087 (0.0532)	-0.0122 (0.0518)
BMI - Mother	-0.1474 (0.0331) *	-0.1335 (0.0346) *	0.1119 (0.0337) *
96 ≥ age ≥ 72 months			
BMI - Children	-0.0251 (0.1007)	-0.0845 (0.1020)	-0.0325 (0.0984)
BMI - Mother	-0.0688 (0.0539)	-0.0960 (0.0546)	-0.0853 (0.0527)
120 ≥ age > 96 months			
BMI - Children	0.0652 (0.0890)	0.1192 (0.0923)	0.0730 (0.0918)
BMI - Mother	-0.2377 (0.0571) *	-0.2163 (0.0592) *	-0.0881 (0.0589)
144 ≥ age > 120 months			
BMI - Children	0.1096 (0.0807)	-0.0133 (0.0874)	-.0460 (0.0836)
BMI - Mother	-0.1241 (0.0601) *	-0.0774 (0.0650)	-0.1497 (0.0622) *

Note: Values in the parenthesis are standard errors. Asterisks indicate significance at 5% level. Coefficients of control variables are suppressed. Appropriate measures are taken to avoid dummy variable trap. The control variables used in the study include age of mother, number of children of mother, family size, mothers' work type (binary), residence in urban or rural area (binary), mothers' marital status (binary), region of residence (binary), log of income of mother, highest grade completed by mother, alcohol consumption (binary), age of child, behavioral index, race (binary), sex (binary), residence in mothers' household or not (binary).

Table 4 gives the fixed effect regression results. Within and between the groups are considered. When within effects are considered, in most cases both child bodyweight and mother bodyweight do not show any relationship with educational achievements. The reason

may be that mothers already have a certain weight status and that does not change that much in next 2 or 4 years to exert an impact on the children's educational performance. Nonetheless, results indicate that even after controlling for unobservable omitted variables' effect there is no relationship between childhood education and bodyweight. When between the groups (individuals) effects are considered, BMI of children does not explain the educational test scores, but mother BMI once again (significantly) negatively affect the children's academic performance. However, between-person variation is very likely to be contaminated by unmeasured personal characteristics that are correlated with bodyweight of children and mothers.

Table 4. Fixed Effect Regression Results

Explanatory Variable	Dependent Variable			Dependent Variable		
	Within Effect			Between Effect		
	PIAT- M	PIAT- R	PIAT - C	PIAT- M	PIAT- R	PIAT - C
<i>Panel A: Full Sample</i>						
BMI - Children	0.0226 (0.0628)	0.0518 (0.0547)	-0.0483 (0.0636)	0.0301 (0.0611)	0.0102 (0.0648)	0.0346 (0.5840)
BMI - Mother	0.1084 (0.0815)	0.0060 (0.0709)	0.0030 (0.0825)	-0.2040 (0.0405)*	-0.1775 (0.0429)*	-0.1970 (0.0386)*
<i>Panel B: Fixed Effects based on Sex</i>						
<i>Sex: Male</i>						
BMI - Children	0.0513 (0.0967)	0.0896 (0.1060)	0.0413 (0.0987)	0.0450 (0.0918)	0.1773 (0.0997)	0.2197 (0.0897)
BMI - Mother	0.1818 (0.1195)	-0.0460 (0.1060)	0.0007 (0.1220)	-0.3218 (0.0605)*	-0.3413 (0.0658)*	-0.3340 (0.0592)*
<i>Sex: Female</i>						
BMI - Children	0.0016 (0.0824)	0.0273 (0.0704)	-0.1096 (0.0815)	0.0343 (0.0821)	-0.1432 (0.0846)	-0.1346 (0.0763)
BMI - Mother	0.0189 (0.1115)	0.0420 (0.0953)	-0.0371 (0.1103)	-0.1032 (0.0542)	0.0246 (0.0559)	-0.6300 (0.0505)*
<i>Panel C: Fixed Effects based on Race</i>						
<i>Race: Non-Black and Non-Hispanic</i>						
BMI - Children	0.0406 (0.0955)	-0.0864 (0.0810)	-0.0913 (0.0948)	0.0164 (0.0891)	-0.0377 (0.0961)	0.0649 (0.0875)
BMI - Mother	0.0569 (0.1223)	-0.2080 (0.1037)*	-0.1484 (0.1215)	-0.1608 (0.0544)*	-0.1529 (0.0588)*	-0.1546 (0.0534)*
<i>Race: Black and Hispanic</i>						
BMI - Children	0.1069 (0.0846)	0.1931 (0.0753)*	0.0335 (0.0876)	0.0285 (0.0862)	0.0587 (0.0892)	0.0326 (0.0798)
BMI - Mother	0.2607 (0.1113)*	0.1821 (0.0991)	0.1477 (0.1152)	-0.2485 (0.0618)*	-0.2149 (0.0640)*	-0.2498 (0.0572)*

Note: Values in the parenthesis are standard errors. Asterisks indicate significance at 5% level. Coefficients of control variables are suppressed. Appropriate measures are taken to avoid dummy variable trap. The control variables used in the study include age of mother, number of children of mother, family size, mothers' work type (binary), residence in urban or rural area (binary), mothers' marital status (binary), region of residence (binary), log of income of mother, highest grade completed by mother, alcohol consumption (binary), age of child, behavioral index, race (binary), sex (binary), residence in mothers' household or not (binary).

Hausman test is performed to determine whether fixed effect or random effect is a preferred model. The null hypothesis of random effect is the correct model is rejected at 5% level of significance. Thus only fixed effect models are pursued and the relevant results are provided here.

5. Conclusion

The rapid growth of adult and childhood obesity has been a major public health policy concern in the last two decades. In this backdrop, this paper endeavors to investigate the relationship between bodyweight of children and mothers and children's academic performance. NLSY data for the period from 1986 through 2006 have been used in the study.

There is only handful of studies on this issue. Further study will be able to bridge the gap between the inconsistencies of these few investigations. Some authors believe that overweight students are discriminated which is responsible for adverse educational outcomes. Findings of this paper show that this is probably not the case. Moreover, it is found that mothers' bodyweight is an important factor for childhood educational outcomes. This is probably one of the direct adverse effects of obesity of adult women.

The results of the paper do not support results found in Datar and Strum (2006) and Averett and Stifel (2007). Results of both papers suggest for negative relationship between becoming overweight and academic achievement. Moreover, Sabia (2007) and Sigfusdotirr *et al.* (2006) also find negative relationship between being overweight and academic achievement for adolescents. However, findings of this paper are supported by Kaestner and Grossman (2008) who find that there is insignificant difference of academic performance between obese and average weight children although this paper uses continuous BMI as independent variable instead of categorical (change of weight status) ones. One common thing between this paper and Kaestner and Grossman (2008) is that in both these papers NLSY data are used. Other papers use data from sources other than NLSY. Another similarity is that both these papers concentrate on childhood obesity whereas Sabia,

Sigfusdotir *et al.*, and Averett and Stifel focus on adolescents. Future studies should be able to minimize these empirical inconsistent findings.

References:

- Averett, S. C., and D. C. Stifel. 2007. Food for thought: The cognitive effects of childhood malnutrition in the United States. Mimeo. Lafayette College.
- Baum, C. L., and W. F. Ford. 2004. The wage effects of obesity: A longitudinal study. *Health Economics* 13: 885 – 899.
- Cawley, J., and S. Danziger. 2004. Obesity as a barrier to the transition from welfare to work. Paper presented at the Second International Conference on Economics and Human Biology, Munich, Germany.
- Cawley, J. 2004. The impacts of obesity on wages. *Journal of Human Resources* 39: 451 – 74.
- Crosnoe, R., and C. Muller. 2004. Body mass index, adolescent achievement, and school context: Examining the educational experiences of adolescents at risk of obesity. *Journal of Health and Social Behavior* 45: 393 – 407.
- Datar, A., and R. Sturm. 2006. Childhood overweight and elementary school outcomes. *International Journal of Obesity* 30: 1449 - 1460.
- Edwards, L. N., and M. Grossman. 1979. Adolescent health, family background, and preventive medical care. In *Health: What is it Worth*, edited by Selma J. Mushkin and D. W. Dunlop, Elmsford, New York: Pergamon Press. pp. 273 – 314.
- Fertig, A., G. Glomm, and R. Tchernis. 2006. The connection between maternal employment and childhood obesity: Inspecting the mechanisms. Working Paper. Center for Applied Economics and Policy Research.
- Gortmaker, S. L., A. Must, J. M. Perrin, A. M. Sobol, and W. H. Deitz. 1993. Social and economic consequences of overweight in adolescence and young adulthood. *New England Journal of Medicine* 329: 1008 – 12.
- Hofferth, S. L., and S. Curtin. 2003. Food program and obesity among US children. Paper presented at the annual meeting of the Association for Public Policy Analysis and Management, Washington D.C.
- Kaestner, R., and M. Grossman. 2008. Effects of weight on children's educational achievement. Working Paper No. 13764. National Bureau of Economic Research.
- Kimm, S., E. Obarzanek, B. Barton, C. Aston, S. Similo, and J. Morrison. 1996. Race, socio-economic status, and obesity in 9 to 10-year-old girls: The NHLBI Growth and Health Study. *Academy of Epidemiology and Pediatrics* 6(4): 266 - 275.

- Norton, E. C., and E. Han. 2007. Genetic information, obesity, and labor market outcomes. Working Paper. School of Public Health, University of North Carolina at Chapel Hill.
- Sabia, J. J. 2007. The effect of body weight on adolescent academic performance. *Southern Economic Journal* 73 (4): 871 - 900.
- Sargent, J. D. and D. G. Blanchflower. 1994. Obesity and stature in adolescence and earnings in young adulthood: Analysis of British birth cohort. *Archives of Pediatrics and Adolescent Medicine* 148: 681 – 87.
- Shakoto, R. A., L. N. Edwards, and M. Grossman. 1981. An exploration of the dynamic relationship between health and cognitive development in adolescent. In *Contribution to Economic Analysis: Health, Economics, and Health Economics*. Edited by Jaques Van Der Gaag and Mark Perlman. Amsterdam: North Holland Publishing Company.
- Sigfusdotir, I. D., A. L. Kristjansson, and J. P. Allegrante. 2006. Health behavior and academic achievement in Icelandic school children. *Health Education Research* 22(1): 70 – 80.
- Todd, P.E., and K. I. Wolpin. 2003. On the specification and estimation of the production function for cognitive achievement. *Economic Journal* 113: f3 – f33.